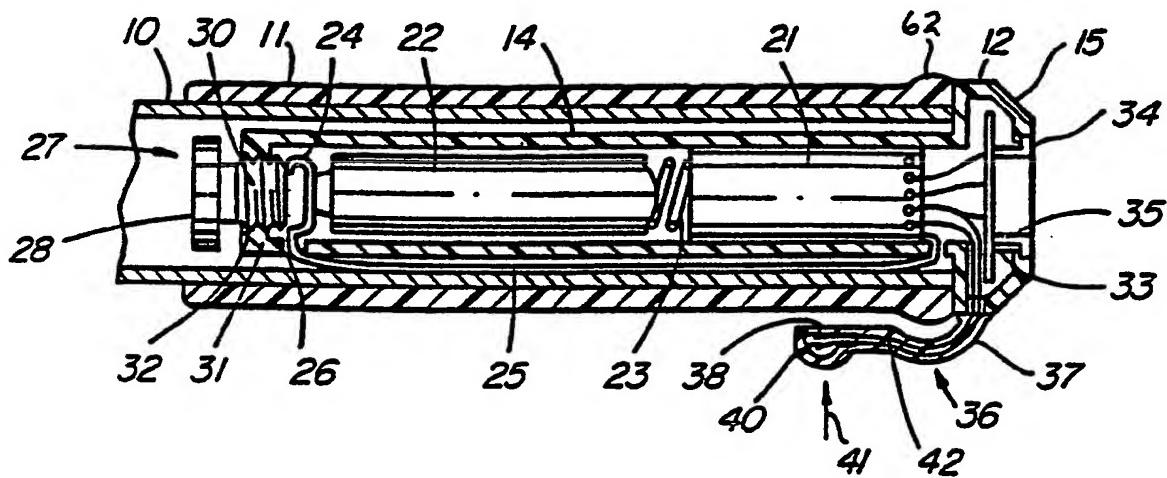




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(54) Title: WARNING DEVICE FOR A BICYCLE



(57) Abstract

A warning device for incorporation in the handle-bar (10) of a bicycle comprises a tubular casing (14) and a transducer housing (15). The tubular casing fits inside the end of the handle-bar while the transducer housing abuts the end of the handle-bar. A flat spring member (25) with an arc-like configuration extends longitudinally outside the tubular casing to engage the inside of the handle-bar and retain the casing in its installed position. The tubular casing houses a battery cell (22) and drive circuitry (23). A piezoelectric transducer (33) mounted inside the transducer housing is connected to the circuitry to form an oscillatory circuit. A pressure operated switch (40) is mounted externally of the transducer housing, preferably carried by a switch arm (36) extending back over the end of the handle-bar. One side of the switch is connected through the spring member to one side of the cell and the other side of the switch is connected to the oscillatory circuit. Closing of the switch supplies power to the oscillatory circuit causing the transducer to generate a warning sound.

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## WARNING DEVICE FOR A BICYCLE

## DESCRIPTION

## TECHNICAL FIELD:

5 This invention relates to a warning device suitable for a bicycle.

## BACKGROUND ART:

The use of bicycles for exercise and recreation as well as for transportation has been increasing and it appears the 10 number of bicycles in use may continue to increase. The large number of bicycles increases the situations in which there may be the threat of an accidental injury due to collisions between bicyclists and other vehicles or pedestrians.

Many bicycles are provided with bells for use as warning 15 devices so that the cyclist may alert other vehicles and pedestrians to the presence of the cyclist. The bell has limitations. The volume of the sound generated by a bell may be too low to alert other vehicles or pedestrians, particularly in a noisy heavy traffic area, and the pitch may 20 be too high.

It is known to use horns instead of bells. Bulb-operated horns mounted upon the handlebars are not convenient to use since the cyclist must remove his hand from the handlebar grip to squeeze the bulb. US patents number 4,941,369 and 25 4,843,905, which are incorporated herein by reference, disclose a horn which is incorporated into a handgrip. When the handgrip is squeezed, air is expelled from a bellows compartment by way of a reed to produce a warning sound. The noise level attainable is limited because the bellows must be 30 small enough to be encompassed by the cyclist's hand.

United States patent No. 4,915,054, Vidovic et al, incorporated herein by reference, describes a special large handgrip which fits over the handle-bar of a bicycle and has a portion extending to one side which incorporates a 35 pressurized gas cylinder. An actuator opens a valve which directs pressurized gas towards a diaphragm. The diaphragm is caused to vibrate, generating a sound which issues from a horn-shaped part extending to one side of the grip. This

warning device requires that the regular handgrip be replaced by a much larger special handgrip which incorporates the pressurized gas cylinder externally of the handle-bar itself, and which extends to one side of the handle-bar.

5 It is, of course, known to incorporate signalling lights as warning devices within the end of a bicycle handle-bar. For example, United States patents Nos. 4,623,954, and 4,716,502, Schott et al, and 4,779,169, Cruze, which are incorporated herein by reference, each show a light assembly 10 which is mounted in the end of a handle-bar and has a light cover or lens projecting beyond the end of the handle-bar to provide a visible light. These assemblies for a safety light are not entirely suitable for use as an audible warning device. Sound generating equipment requires more space than 15 a light bulb and is more complex. Moreover, the switches for operating such lights are not entirely satisfactory.

#### DISCLOSURE OF INVENTION:

According to one aspect of the invention, a warning 20 device for a bicycle comprises a tubular casing for fitting into the end opening of a handle-bar and, at one end of the casing, a housing for a transducer, the housing being configured to protrude from the end of the handle-bar when the tubular casing is inserted into the handle-bar, the tubular 25 casing housing drive circuitry connected with the transducer by switch means mounted to or adjacent the housing and operable by the little finger of a cyclist's hand grasping the handgrip.

30 Preferably, the switch means comprises a switch arm extending from the transducer housing to overlie the handlebar and/or handgrip and carrying a switch operable by pressure against the handlebar and/or handgrip. The switch arm may be pliable to conform to the contour of the underlying handlebar and/or handgrip.

35 In preferred embodiments of the invention, the switch means comprises a pressure-actuated switch, conveniently a membrane or diaphragm switch, housed in a flexible sleeve and

disposed adjacent the handgrip. The switch can be actuated by squeezing the switch member against the handgrip.

The circuitry may comprise a power source, for example an electric cell, housed within the tubular casing. The 5 transducer may emit an audible warning signal and preferably comprises a piezoelectric transducer. The circuitry and the transducer may form an oscillator and may include an amplifier to cause the transducer to vibrate, generating an audible sound.

10 According to a second aspect of the invention, a warning device for a bicycle comprises a tubular casing for mounting into the end opening of a handlebar and having at one end thereof a housing for a transducer, and retaining means preferably in the form of a spring member which has an arc-15 like configuration and extends longitudinally externally of the tubular casing from a position adjacent the housing to the opposite or distal end of the tubular casing, such that, when the tubular casing is inserted into the open end of a handle-bar, the spring member engages the inner surface of the 20 handle-bar and is deformed.

The engagement of the spring member with the inner surface of the handle-bar retains the warning device in position with the tubular casing substantially entirely within the handle-bar. The warning device may be withdrawn by 25 applying sufficient force to overcome the frictional forces due to the engagement between the spring member and the handle-bar.

Preferably, the force exerted by the spring against the handlebar is adjustable, conveniently by means of an adjusting 30 screw member acting against an end of the spring member.

In either aspect of the invention, the housing may advantageously comprise a radial end face with a cylindrical ring portion projecting longitudinally therefrom, the transducer being mounted to said ring portion to form with 35 said end face a chamber, the chamber being vented by at least one port extending through said housing adjacent said ring.

In either aspect of the invention, the housing may comprise an end cap attached to said casing and the switch arm

may comprise two longitudinal parts, each formed integrally with a respective one of the casing and the end cap, the longitudinal parts cooperating to enclose the switch and its connecting wires.

5       The connections between the switch and the circuit board may advantageously comprise a flexible printed circuit strip.

      The warning device is simple and easy to install or mount. The operating switch is readily available for actuation.

10      According to yet another aspect of the invention there is provided a piezoelectric warning device characterized by a housing comprising a radial end face with a cylindrical ring portion projecting longitudinally therefrom, and a piezoelectric transducer mounted to said ring portion to form 15 with said end face a chamber, the chamber being vented by at least one port extending through said housing adjacent said ring.

#### BRIEF DESCRIPTION OF DRAWINGS:

20      Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

      Figure 1 is a sectional side view of a warning device according to the invention;

25      Figure 2 is an exploded sectional view, slightly enlarged, of the device of the invention;

      Figure 2A is a partial sectional side view showing the transducer housing of an alternate form of the invention;

30      Figure 3 is a schematic diagram showing a form of circuit suitable for use in the invention;

      Figure 4 is a perspective view of a warning device according to the invention;

      Figure 5 is a longitudinal cross-sectional view of a modification of the warning device of Figure 1;

35      Figure 6 is an end view of the modified warning device of Figure 5;

      Figure 7 is partial cross-sectional view of a transducer housing of the device of Figure 5; and

Figure 8 is a schematic circuit diagram for the modified warning device of Figure 5.

BEST MODE(S) FOR CARRYING OUT THE INVENTION:

5       Figure 1 shows the end of a handle-bar 10 having thereon a handgrip 11. The ends 12 of the handle-bar 10 and the handgrip 11 are conveniently co-extensive. An audible warning device, shown also in Figure 2, comprises a tubular casing 14 having at one end a transducer housing 15 formed by a radially 10 extending flange 16, a cylindrical flange extending longitudinally from the radial flange 16, and a cap portion 18. With the casing 14 located in the end of handlebar 10, the radially extending flange 16 serves as an abutment, for abutting the end of the handlebar 10. The tubular casing 14 15 and the transducer housing 15 are preferably of an insulating material, such as a plastics material, for example polypropylene.

Referring for the moment to Figure 2, which shows components of the housing 15 separated, the cap 18 is secured 20 to flange 17 using an adhesive, such as an epoxy resin type adhesive.

An alternative arrangement is shown in Figure 2A which shows a base flange 16 with a cylindrical flange 17 as in Figure 2, but differs in that it shows a cap 18A which extends 25 outwardly of flange 17 and has, at spaced points on its periphery, inwardly directed clips or fastening members 20 which project behind base 16 when cap 18A is installed to hold cap 18A against flange 17. It will be seen in Figure 2A that the end of handgrip 11 is recessed slightly to accommodate 30 clips 20. Alternatively the base 16 may be spaced outwardly a short distance.

Referring once again to Figure 1 and to Figure 2, the tubular casing 14 has a circuit board 21 mounted at the proximal end, that is at the end adjacent the tubular housing 35 15. The circuit board 21 carries drive circuitry which is not shown in this drawing, but will be described subsequently with reference to Figure 3. In connection with a power source, such as an electric cell 22 or a battery if the tubular casing

is lengthened, also contained within tubular casing 14, the drive circuit 21 constitutes a power supply for the warning device. A spring contact 23 interconnects an end of cell 22 and the circuitry of circuit board 21. The other end of cell 5 22 contacts an end 24 of a longitudinally extending, flat leaf spring member 25 of electrically conducting material. The spring member 25 passes through an opening 26 in tubular casing 14 at the distal end, and extends longitudinally of the casing to the proximal end of tubular casing 14, that is 10 substantially to the junction of tubular casing 14 and housing 15, where it passes through the casing and projects within the compartment formed by the casing walls.

An end cap or closure 27 has a head 28 and a screw portion 30. There may be a small internal flange 31 at the 15 distal end of tubular casing 14 which has an internal thread 32 for threaded engagement with screw portion 30. When the screw portion 30 of closure 27 is engaged with thread 32 and closure 27 rotated, the end of closure 27 engages the end 24 of spring member 25 and presses the end 24 inwardly against 20 the terminal of cell 22. This ensures good contact and also biases spring member 25 outwardly into an arc-like configuration. When tubular casing 14 is inserted into the handle-bar 10, the arc-like configuration deforms slightly as 25 the spring member 25 is pressed against the inner surface of the handle-bar 10. This ensures good frictional engagement and retains the tubular casing 14 firmly inside handle-bar 10. The tubular casing 14 may be withdrawn by application of sufficient force to housing 15 enabling the warning device to be readily removed when the bicycle is to be left unattended.

30 Within housing 15 is a piezoelectric transducer 33, such as is available commercially under the type name PKM29-3A0 by Murata Manufacturing Co. Ltd., Japan. The transducer 33 is mounted, for example by bonding with an adhesive, to a tubular insert 34 in housing 15. Sound vibrations generated by 35 transducer 33 are emitted through opening 35 defined by the walls of tubular insert 34. The opening 35 may, if desired, be sealed by a flexible plastic membrane to exclude moisture.

The piezoelectric transducer has three connections made

to it. These connections are a power connection, a feedback connection, and a common connection or "ground". As shown in Figure 2A, three pads or projections 43, 44, 45 formed on the inner surface of base 16 are connected by wires to the 5 circuitry, and engage appropriate points on the transducer 33 when the housing 15 is assembled. This manner of making connections between the circuitry of board 21 and transducer 33 when it is installed may also be used for the housing configuration of Figure 2. The pads will be referred to in 10 connection with Figure 3.

Mounted to the side of housing 15 is a switch arm 36. Switch arm 36 has an elongate member 37, one end of which extends into, and seals, a slot in the flange 17. The other end of member 37 terminates in a flat sleeve portion 38 15 containing a pressure-operated membrane switch 40. Two lengths of stiff, yet pliable, copper wire 42A and 42B, respectively, extend through the member 37 to connect the switch 40 to the circuit board 21, as will be described later with respect to Figure 3.

20 The member 37 is preferably of flexible insulating material, such as a plastics material, and the flat sleeve member 38 is of a compressible or highly flexible insulating material defining a space in which switch 40 is mounted. The pliability of the copper wires 42A and 42B allows the switch 25 arm to be conformed to the surface of the handgrip by firm pressure on sleeve 37 once the device has been installed in the handle-bar.

To operate the warning device, pressure is applied to switch arm 36, particularly pressure in the area indicated by 30 arrow 41 (Figure 1), to press switch arm 36 against handgrip 11 and flex the material of flat member 38 to compress and close membrane switch 40.

Referring now to Figure 3, there is shown one simple form of circuitry suitable for use in the device of the 35 invention. Suitable known alternative forms of circuitry may be used. Cell 22 is shown connected to the base of transistor 46 which is on circuit board 21. The collector of transistor 46 is connected through a series arrangement of resistors 47

and 48 to a conductor 50. Conductor 50 is connected to pad 45 and represents a common or ground connection. The emitter of transistor 46 is connected via resistor 51 and conductor 52 to pad 43. This represents the drive connection or power connection. Conductor 53 is connected at one end to pad 44 and at the other end to the junction between resistors 47 and 48. This represents the feedback connection from transducer 33. The other terminal of cell 22 is connected to one side of switch 40 by way of spring member 25 and conductor or wire 42A. The other side of switch 40 is connected by wire 42B to the conductor 50. The transducer 33 and the associated circuitry oscillate when switch 40 is closed, causing transducer 33 to vibrate and generate sound.

It will be apparent that stages of amplification could be included in the circuitry of Figure 3. Moreover, the drive circuit might include an inverter stage to allow the device to be used with a power source having an operating voltage significantly lower than that of the piezoelectric transducer.

In Figures 5, 6 and 7, which illustrate a warning device similar to that shown in Figure 1, but incorporating several modifications to improve sound operation and/or facilitate manufacture, parts corresponding to those in Figure 1 have the same reference numbers but with a prime. Thus, in the warning device of Figure 5, a tubular casing 14' has a transducer housing 15' formed by a radial flange 16' at one end of the casing 14' and a cap 18'. The radial flange 16' and juxtaposed edge of cap 18' are stepped to complement each other as indicated at 19' and bonded using adhesive, as before. The cap 18' also differs from those shown in Figures 2 and 2A in that it has no central opening and insert 34. Instead, cap 18' is shaped as a truncated cone with a conical portion 55 and a flat truncation 56. As shown also in Figure 8, two orifices 35' spaced diametrically at the junction between the conical portion 55 and flat portion 56 serve as ports for the sound from the transducer 33'. A ring 34' extends longitudinally inwards from the conical portion 55 and terminates in a knife edge at its distal end. The diameter of ring 34' is substantially equal to the diameter of the flat

portion 56 and serves as a nodal support for the piezoelectric transducer 33' which is bonded to its knife edge. The piezoelectric transducer 33', nodal support ring 34' and flat cap portion 56 form an acoustic chamber, the dimensions of 5 which can be selected to optimize sound output for a particular piezoelectric transducer 33'.

A printed circuit board 21' is mounted in the casing 14' and is a close fit across its diameter. Wires 50', 52' and 53' soldered to the piezoelectric transducer 33' connect it 10 to the printed circuit board 21'. A two-wire flexible printed circuit strip 57 is connected at one end to a connector 58 on the printed circuit board 21' and at its other end to the membrane switch 40'. The flexible circuit strip 57 is sandwiched between two flexible strips 59 and 60 which form 15 a flexible switch arm 36'. The flexible strips are formed integrally with the flange 16' and the cap 18', respectively, during moulding, and clipped or bonded together around the flexible printed circuit strip 57 and membrane switch 40' during assembly. The flexible strips are preformed during 20 moulding to protrude away from the housing 15' and then curve towards it, forming an arcuate portion 61 to provide clearance should the handlebar grip have a lip 62 (Figure 1) adjacent its end. The leaf spring member 25' extends through a hole in the flange 16' and is returned to lie against the interior 25 of casing 14'. A "Z" shaped spring clip 63 is soldered at one end to the printed circuit board 21' and bears against the returned end of leaf spring member 25' to make electrical contact in a manner which provides easy assembly of the printed circuit board into the casing 14'. At its other end, 30 printed circuit board 21' is reduced in width to form a spigot 64. Helical contact spring 23' has a tightly coiled section 65 at one end which grips the spigot 64 and makes electrical contact.

In the modified circuit illustrated in Figure 7, the 35 transducer 33' has its ground G connected in common with the cathode of a diode 66 and the emitter of transistor 67 to one terminal of the cell 22'. The other terminal of cell 22' is connected by way of leaf spring member 25', Z-shaped spring

contact 63, and membrane switch 40' to one terminal of an inductor 68 which is in parallel with a pair of series connected resistors 69 and 70. The other terminal of inductor 68 is connected in common with the collector of transistor 67 5 to the main or drive terminal M of the transducer 33'. The anode of diode 66 and the base of transistor 67 are connected in common to the other end of series resistors 69 and 70. The midpoint of the resistors 69 and 70 is connected to the feedback terminal F of the transducer 33'.

10

#### INDUSTRIAL APPLICABILITY

Embodiments of the invention provide a loud sound when actuated to alert the drivers of other vehicles, and pedestrians, of the presence of a bicyclist that has the 15 device installed. In embodiments of the invention in which the transducer is housed in a chamber formed by a closed end face of the housing, with a cylindrical nodal support and one or more lateral ports, the sound output may be optimized by tuning the dimensions of the chamber. The warning device is 20 easily installed, and is of simple design and configuration, especially when the switch arm is formed in two halves moulded with the respective one of the casing and the housing.

One advantage of embodiments of the invention is that they provide a warning device for a bicycle which is readily 25 mounted within the handle-bar of a bicycle and readily removed by the cyclist to avoid its theft when the bicycle is left unattended.

An advantage of other embodiments of the invention is that they provide a warning device for a bicycle that is of 30 simple construction with a readily accessible operating switch which, in some cases, can be operated by the cyclist's little finger while the index and middle fingers are applying pressure to a brake lever.

## CLAIMS:

1. A warning device suitable for a bicycle,  
characterized by a tubular casing (14) for fitting within the  
5 end of a bicycle handle-bar (10) or the like and having at one  
end a transducer housing (15) to protrude from the end of said  
handle-bar;

10 circuit means (21) in said tubular casing;  
a transducer (33) in said transducer housing and  
connected with said circuit means by switch means (40) for  
controlling operation of said transducer, said switch means  
being mounted to or adjacent said transducer housing and being  
operable by the little finger of a cyclist's hand grasping  
said handle-bar.

15

2. A warning device as claimed in claim 1,  
characterized in that said switch means comprises a switch arm  
(36) extending from said transducer housing to overlie a  
handgrip of said handle-bar when said warning device is  
20 installed.

25 3. A warning device as claimed in claim 2,  
characterized in that said switch arm comprises a pressure-  
actuable switch (40) housed in a flexible sleeve (37).

4. A warning device as claimed in claim 2 or 3,  
characterized in that said switch arm is flexible and  
conformable to said handgrip.

30 5. A warning device as claimed in claim 2, 3 or 4,  
characterized in that the switch arm comprises two  
longitudinal parts (59,60), the parts being formed integrally  
with the casing and housing, respectively, and cooperating to  
form a flexible sleeve for said switch.

35

6. A warning device as claimed in claim 5,  
characterized in that a flexible circuit strip (57) extends

within said switch arm and interconnects said switch and said circuit board.

7. A warning device as claimed in any one of claims 1 to 6, characterized in that said transducer is operable to emit an audible warning signal.

8. A warning device as claimed in claim 5, characterized in that said transducer comprises a piezoelectric device (33), said circuit means and said piezoelectric device comprising an oscillatory circuit.

9. A warning device as claimed in any one of claims 1 to 8, characterized in that said circuit means comprises at least one electric cell (22).

10. A warning device as claimed in any one of claims 1 to 9, further characterized by a spring member (25) extending longitudinally outside said tubular casing and secured by its opposite end portions thereto, said spring member being biased into an arc-like configuration for engagement with the inner surface of said handle-bar to retain said tubular casing therein.

25 11. A warning device for a bicycle, comprising a tubular casing (14) for fitting within the end of a bicycle handle-bar and having at one end a transducer housing (15) for protruding from the end of said handle-bar, circuit means (21) in said tubular casing, a transducer (33) in said transducer housing 30 and connected with said circuit means, characterized by a spring member (25) extending outside said tubular casing a major part of the length thereof and having an arc-like configuration for engaging the inside of said bicycle handle-bar for retaining said casing in position.

12. A warning device as claimed in claim 10 or 11, characterized by means (27) for adjusting the spring force exerted by said spring member.

13. A warning device as claimed in claim 12, characterized in that one end portion of said tubular casing is screwthreaded and said means for adjusting comprises a correspondingly screwthreaded end cap (28, 30), one end (24) 5 of said spring member engaging the end cap such that, as the end cap is tightened, a medial portion of said spring member is biased away from said tubular casing.

14. A warning device as claimed in claim 10, 11, 12 or 10 13, characterized in that said spring member comprises an electrical conductor, said circuit means comprises said spring member and an electric cell (22), and said end cap urges said one end of said spring member into contact with a terminal of said cell.

15

15. A warning device as claimed in claim 10, 11, 12, 13 or 14, characterized in that one end of said spring member extends into said casing and a second spring member (64) extends between said circuit board and said one end of the 20 first spring member to provide a releasable electrical connection therebetween.

16. A warning device as claimed in any one of the preceding claims, characterized in that the transducer housing 25 comprises an abutment (16) for abutting the end of the handle-bar and/or handgrip when the tubular casing is installed in the handle-bar.

17. A warning device as claimed in any preceding claim, 30 characterized in that said housing comprises a radial end face (56) with a cylindrical ring portion (34') projecting longitudinally therefrom, the transducer being mounted to said ring portion to form with said end face a chamber, the chamber being vented by at least one port (35') extending through said 35 cap adjacent said ring.

18. A warning device as claimed in claim 17, characterized by a pair of diametrically spaced said ports.

19. A warning device as claimed in any one of claims 1 to 16, characterized in that said transducer housing comprises a compartment defined by a radially-extending flange (16) at one end of said tubular casing, an axially projecting peripheral flange (17), and a second wall (18) spaced outwardly from said first wall and abutting said flange, said second wall having at least one sound passage (35) therein.

20. A warning device as claimed in claim 19, 10 characterized in that said second wall of said transducer housing is fixed to said flange with an adhesive.

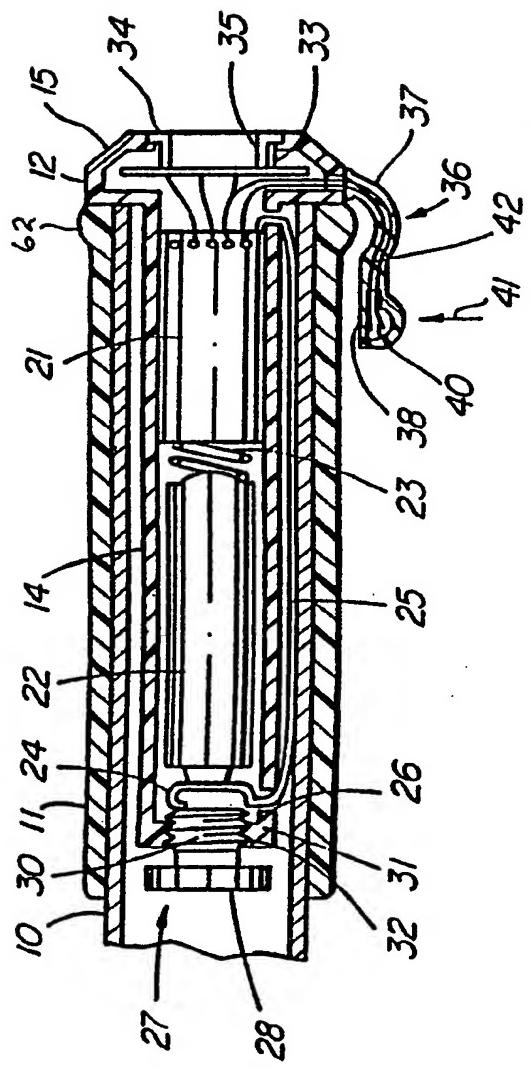
21. A warning device as claimed in claim 19, 15 characterized in that said second wall has a longitudinally projecting peripheral wall portion having an inner diameter just greater than the outer diameter of said peripheral projecting flange, and fastening members (20) spaced around said longitudinally projecting peripheral wall portion of said second wall for engaging said first flat wall to secure said 20 second wall to said flange.

22. A warning device as claimed in any one of claims 1 to 21, characterized in that said casing is of an insulating material.

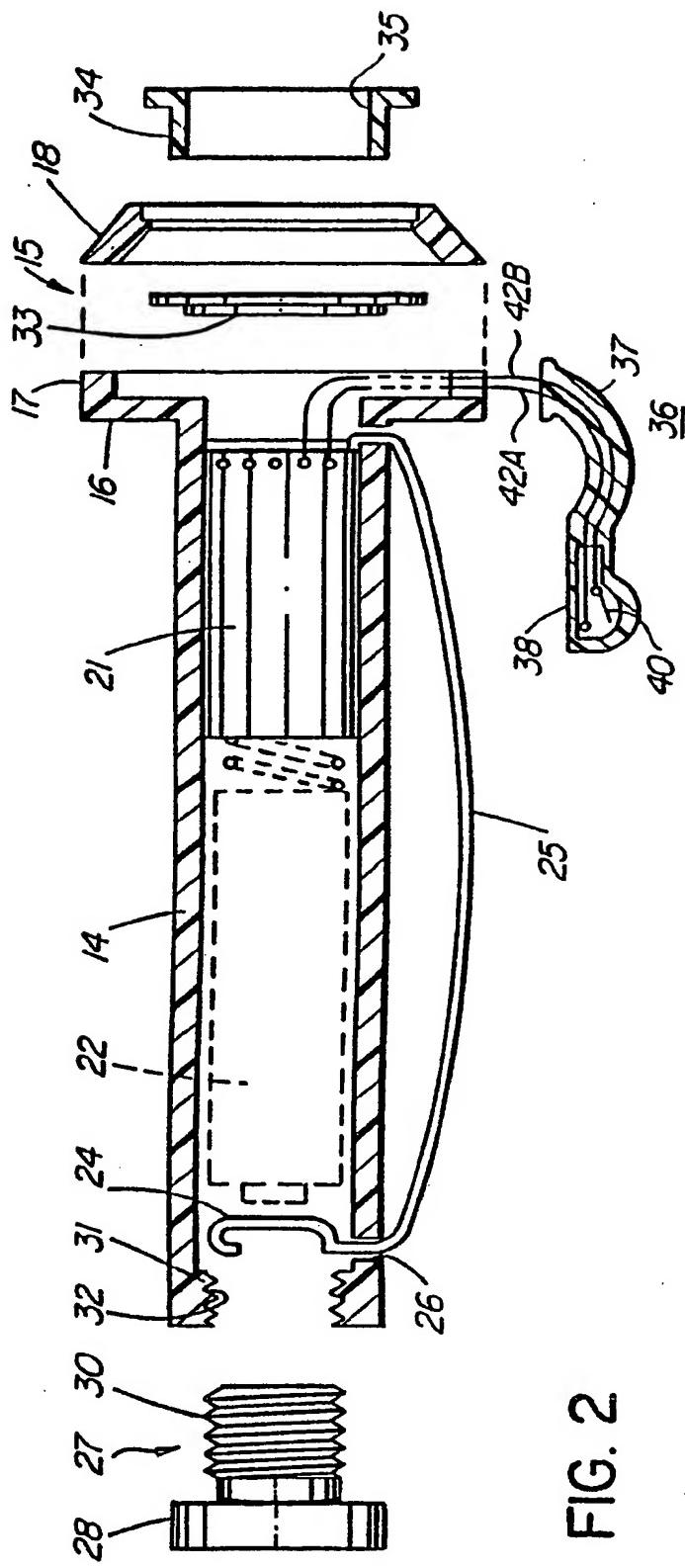
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23. A piezoelectric warning device characterized by a housing comprising a radial end face (56) with a cylindrical ring portion (34') projecting longitudinally therefrom, and a piezoelectric transducer (33') mounted to said ring portion 30 to form with said end face a chamber, the chamber being vented by at least one port (35') extending through said housing adjacent said ring.

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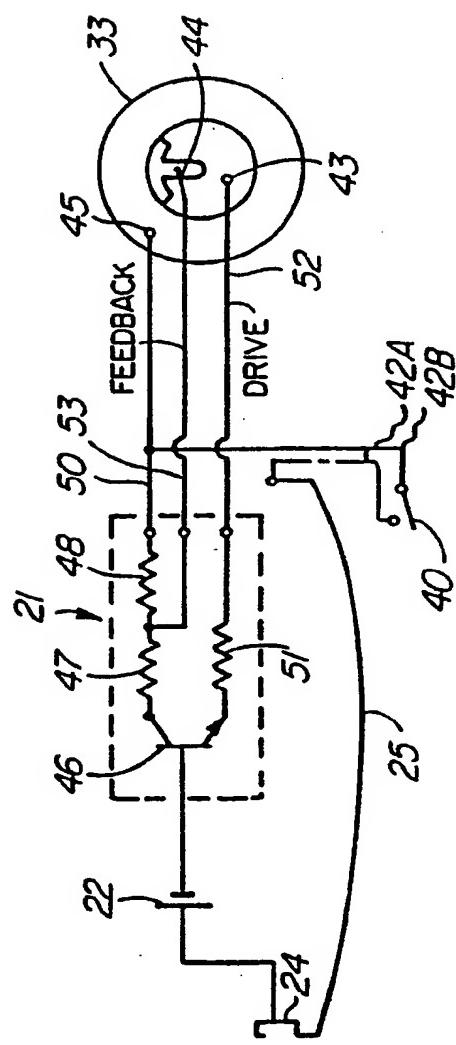
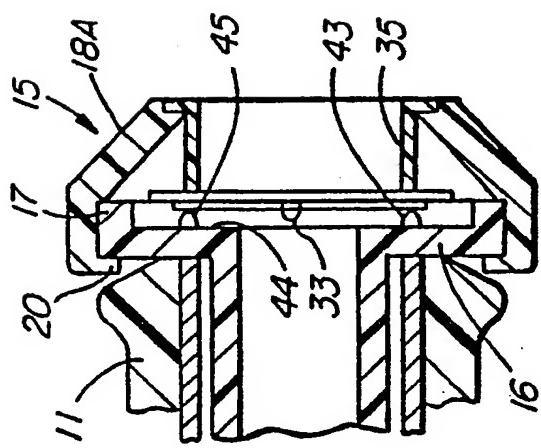
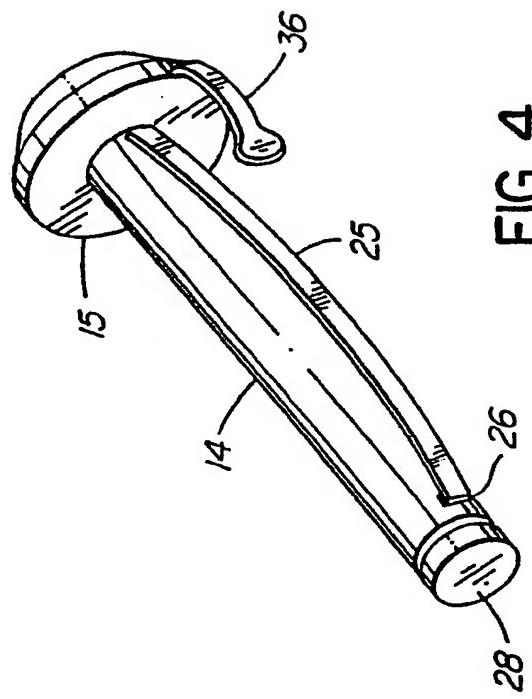


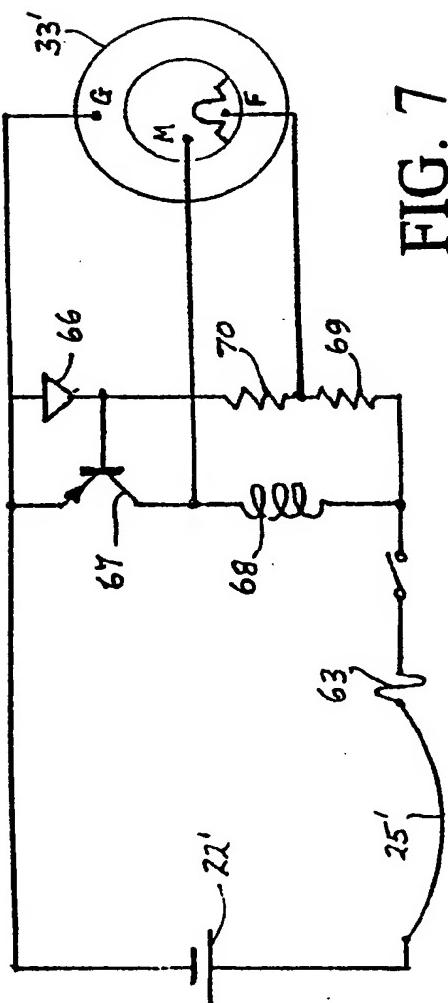
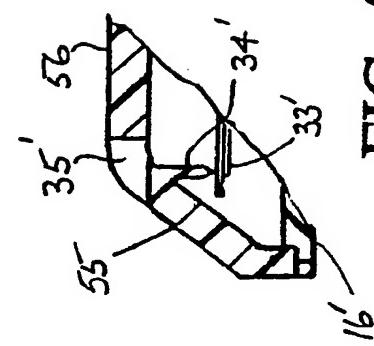
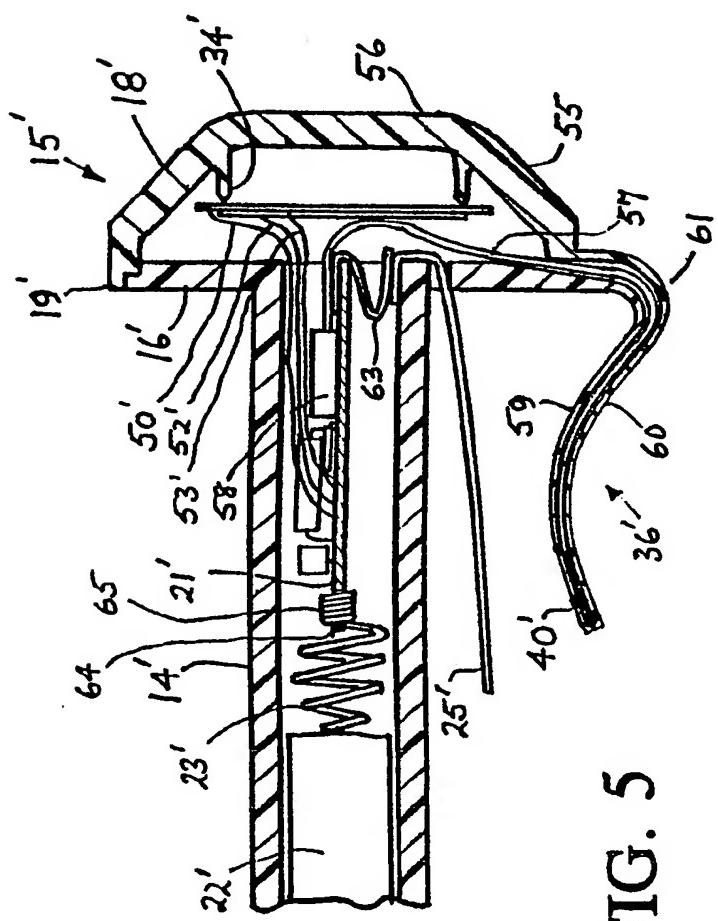
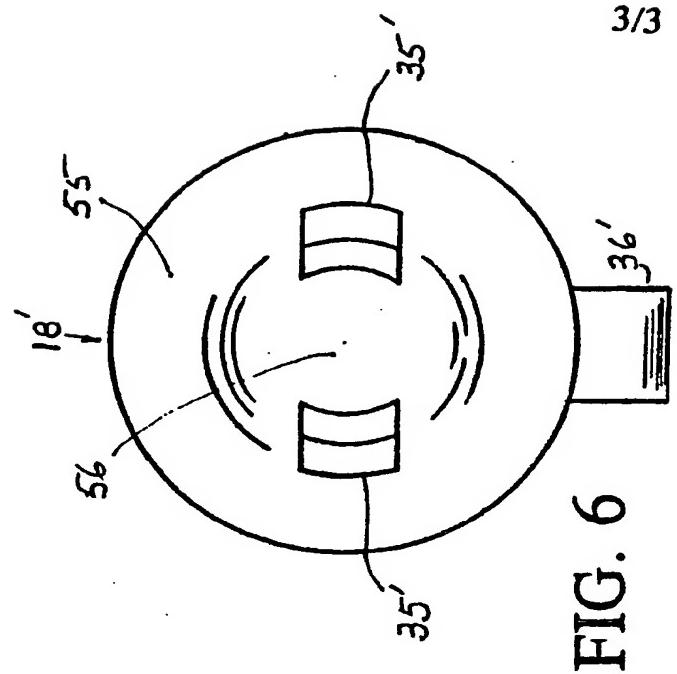
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FIG.



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## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/CA 92/00059

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)<sup>6</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.C1. 5 B62J3/00

## II. FIELDS SEARCHED

Minimum Documentation Searched<sup>7</sup>

Classification System	Classification Symbols	
Int.C1. 5	B62J ;	G04G ; B62K

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched<sup>8</sup>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup>

Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
Y	US,A,4 875 142 (SPECTOR) 17 October 1989 see the whole document	1,11
A	---	9,10
Y	GB,A,2 023 323 (MALLORY) 28 December 1979 see abstract; figures 1,3	1,11
A	---	7,8,23
X	GB,A,2 081 939 (SUWA SEIKOSHA) 24 February 1982 see abstract; figure 2	23
A	---	1,11
A	GB,A,2 078 005 (AISIN SEIKI) 23 December 1981 see the whole document	2-6
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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

3

21 MAY 1992

Date of Mailing of this International Search Report

01.06.92

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

DENICOLAI G.

Giovanni Denicolai

**ANNEX TO THE INTERNATIONAL SEARCH REPORT**  
**ON INTERNATIONAL PATENT APPLICATION NO. CA 9200059**  
**SA 56224**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.  
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